

SALD: Sign Agnostic Learning with Derivatives

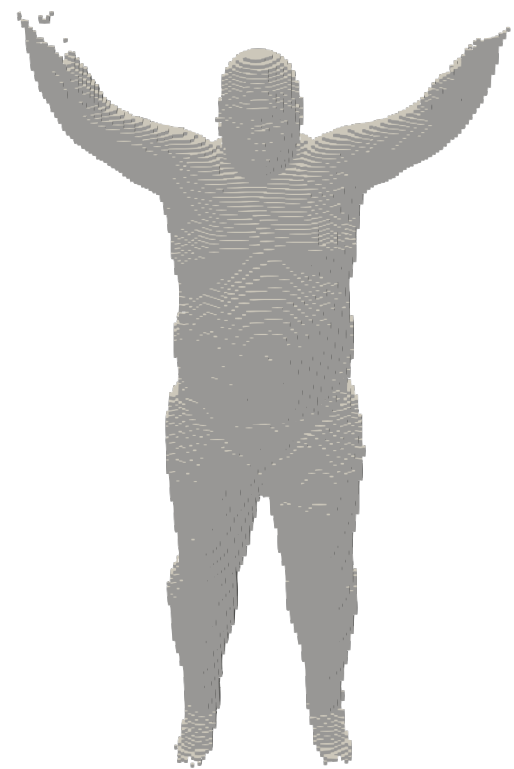
Matan Atzmon and Yaron Lipman



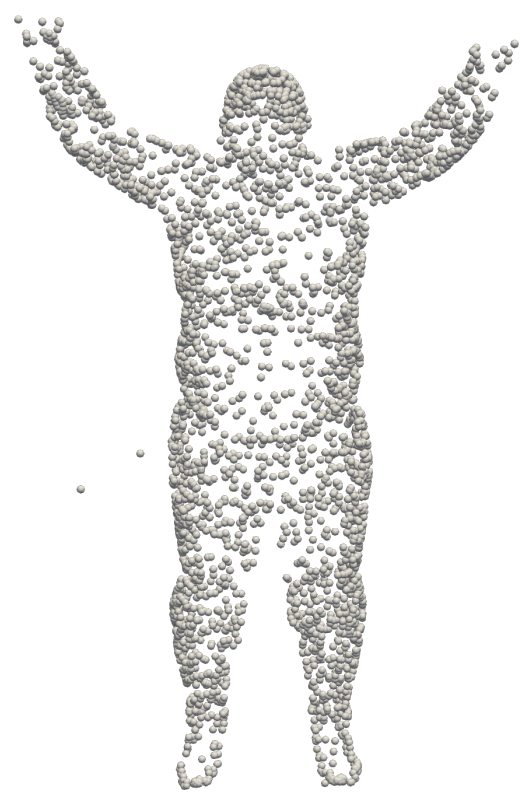
מכון ויצמן למדע
WEIZMANN INSTITUTE OF SCIENCE

Representations of 3D Shapes

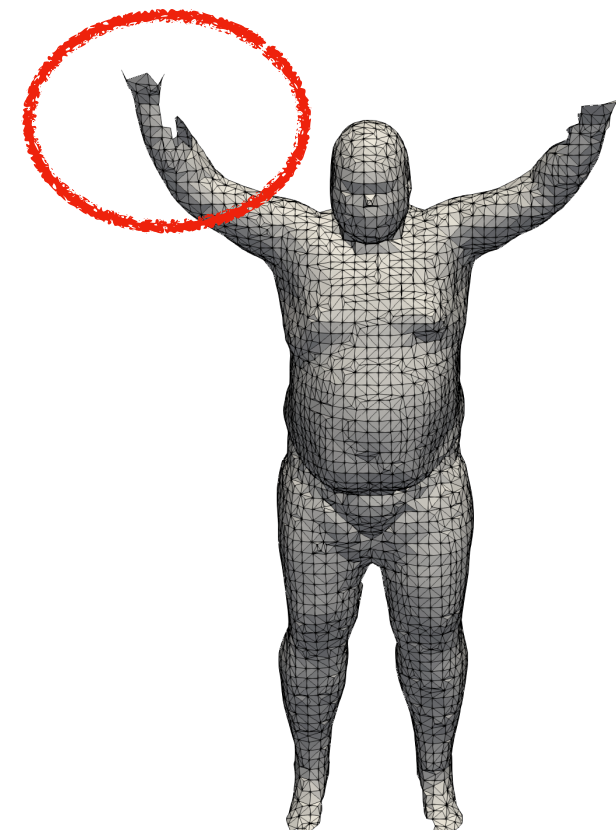
Discrete representations



Voxels



Point Cloud



Triangle Soup

Continuous representations

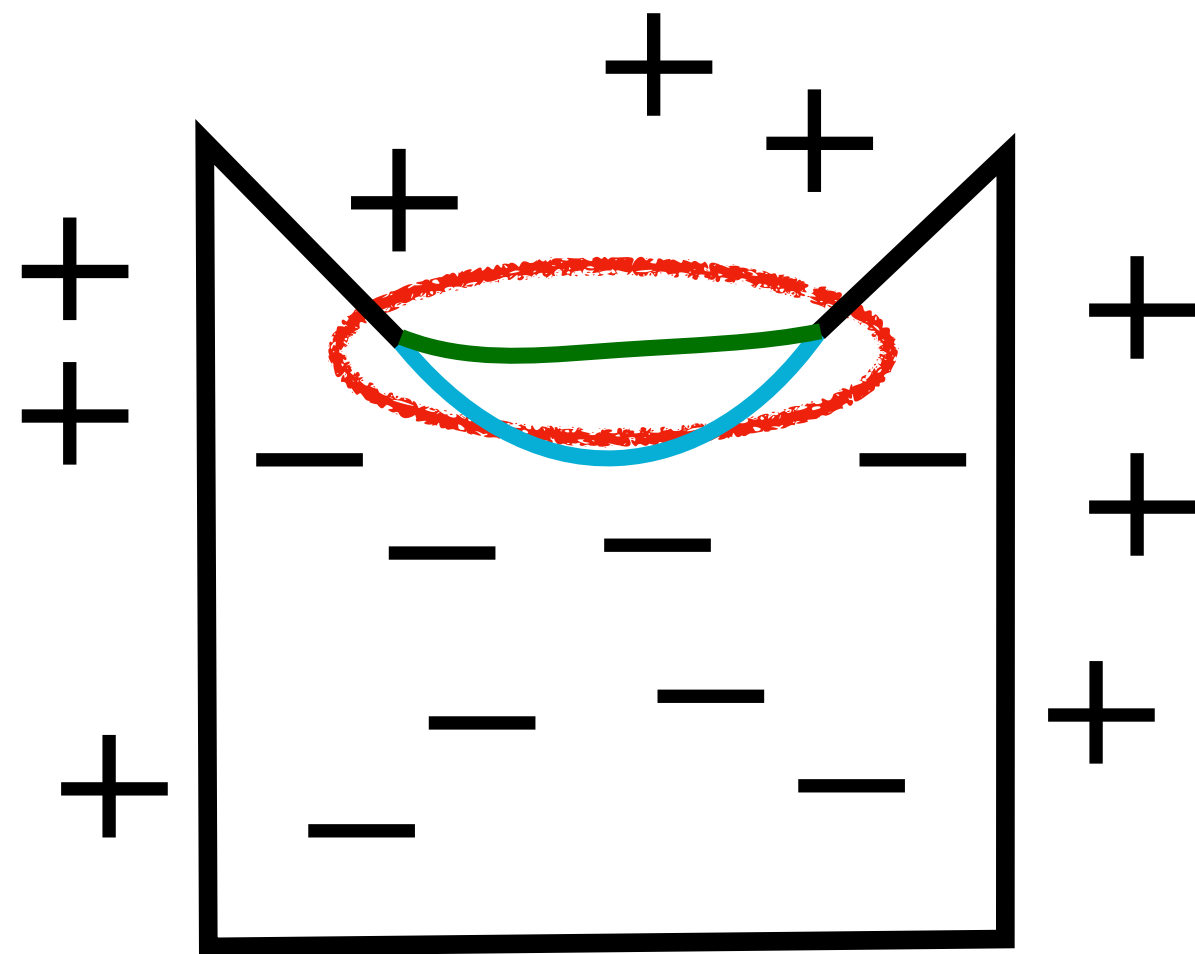
Level Set - $\mathcal{S} = \{x \in \mathbb{R}^3 \mid \underline{f(x; \theta)} = 0\}$



Implicit Neural Representation

Learning Implicit Neural Representations

Toy example



Challenges



- Learn the inside/outside of an input shape

SAL (CVPR, 2020) IGR (ICML, 2020)



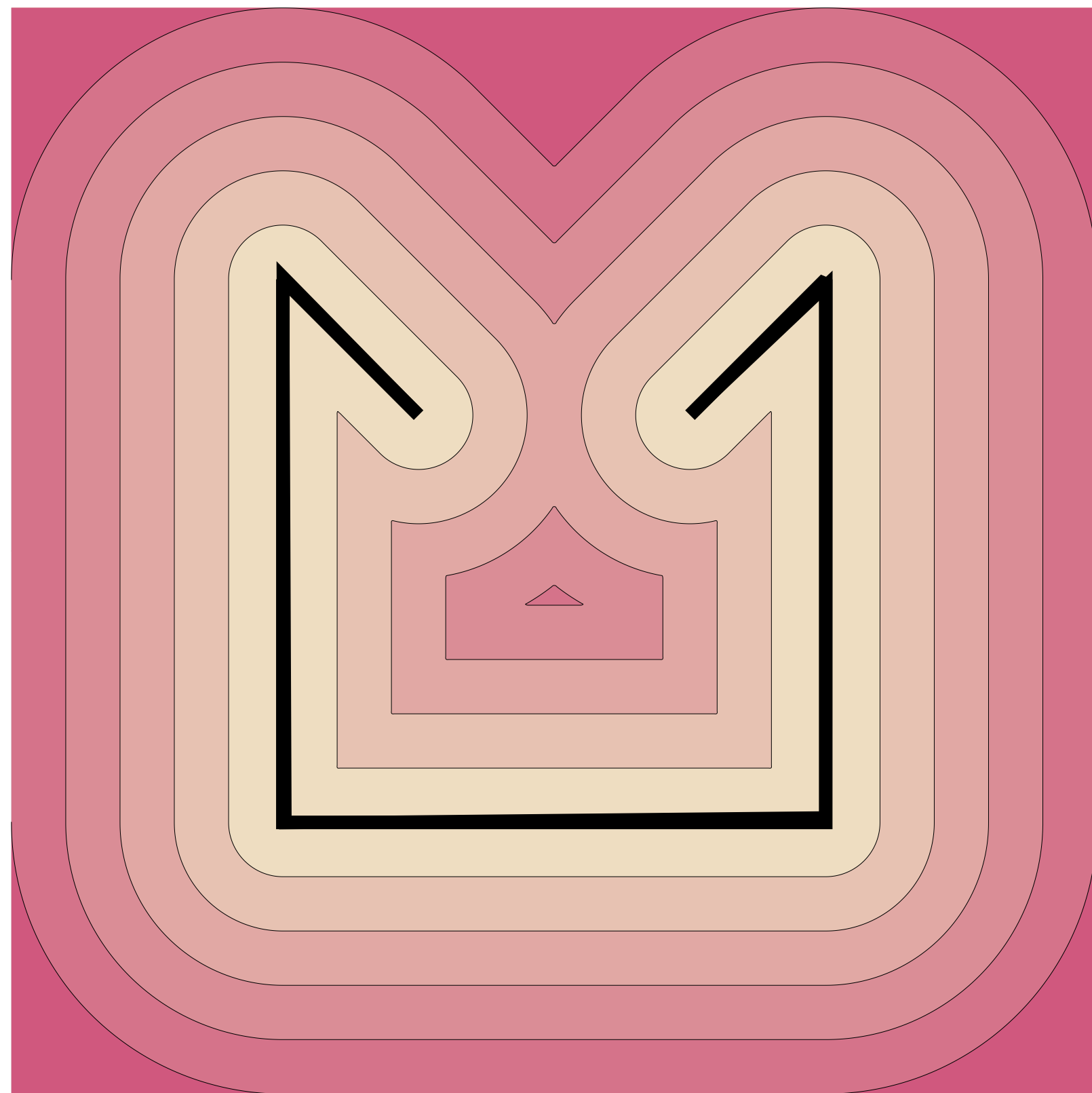
- Identify how missing parts are learned



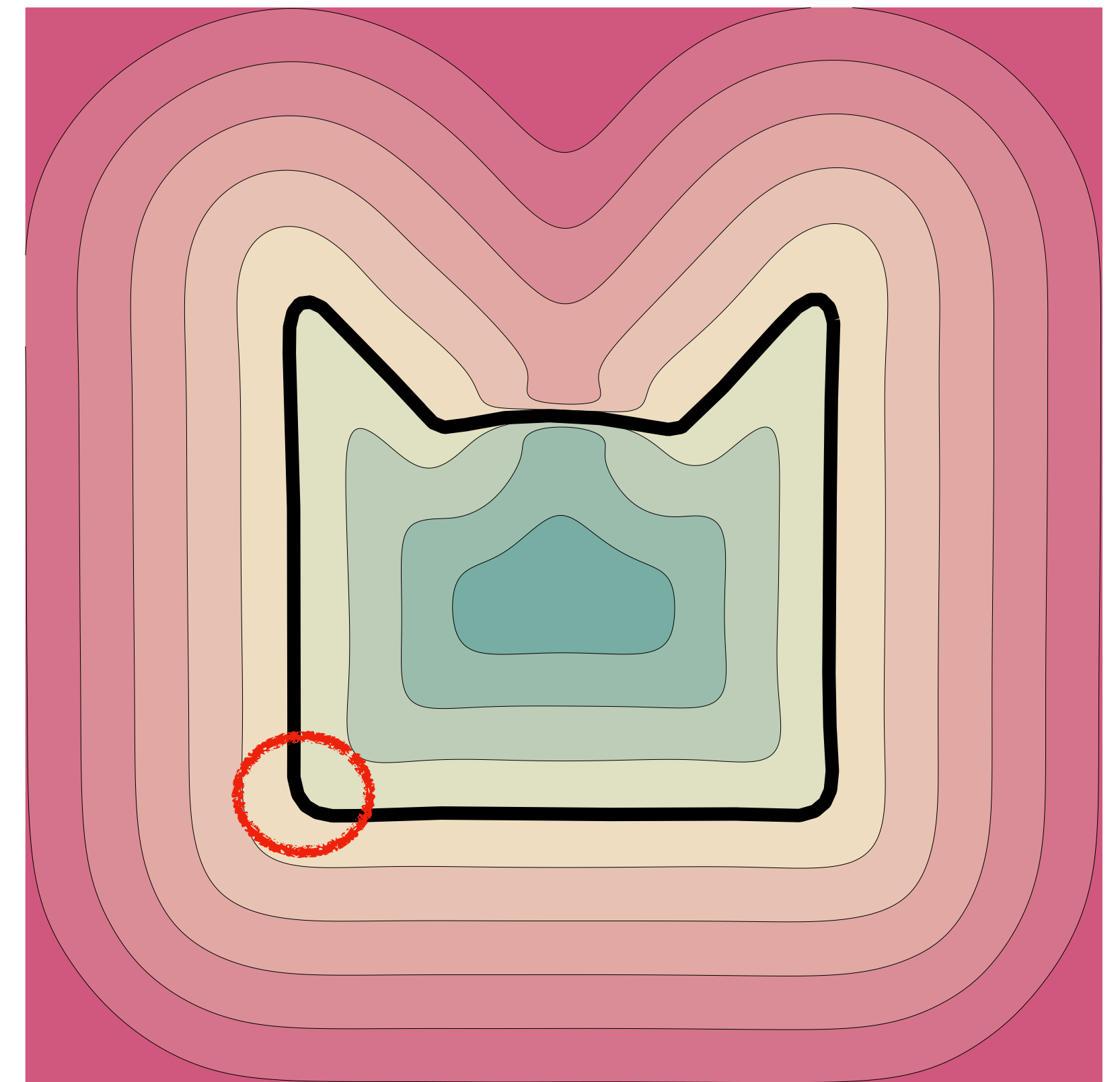
- High fidelity

Background : SAL

Sign Agnostic Loss: $\text{loss}(\theta) = \mathbb{E}_x \tau(f(x; \theta), h(x))$



$$h(x) = \min_{z \in \mathcal{X}} \|z - x\|_2$$



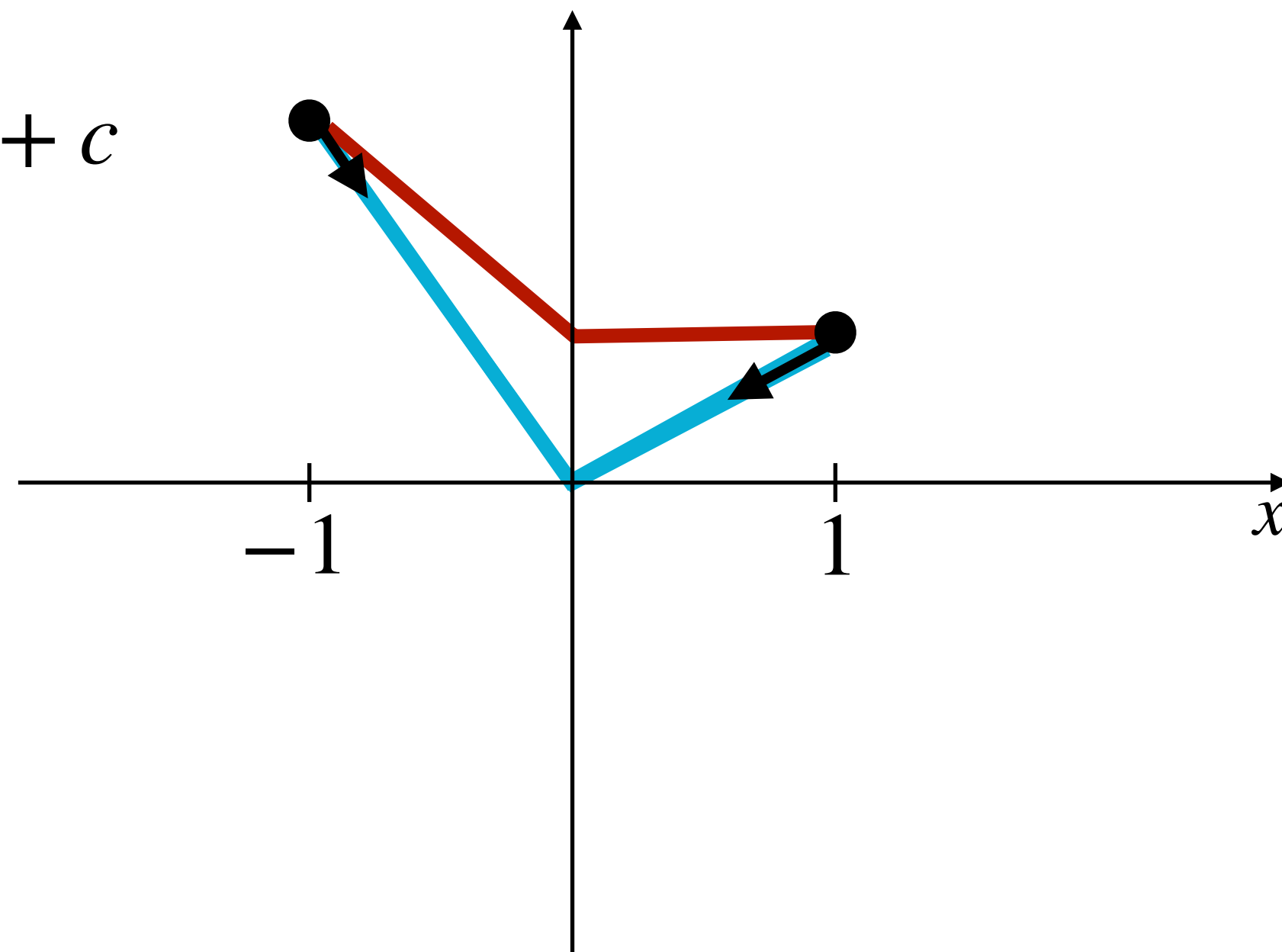
$$f(x; \theta)$$

Sample Complexity

Reducing Sample Complexity by Including derivatives

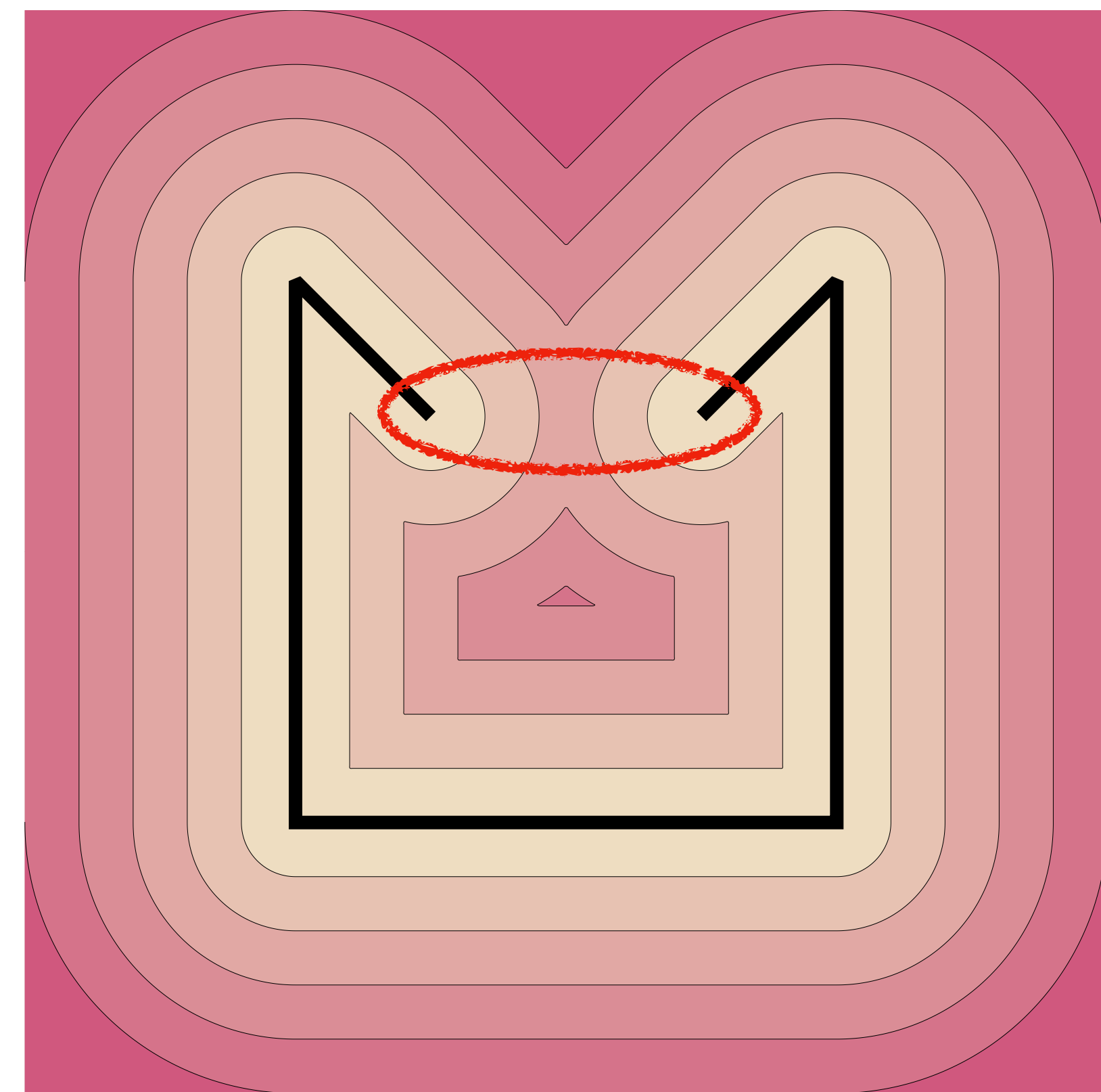
Sobelov Training [Czarnecki et al., 2017]

$$f(x; \theta) = \max \{ax, bx\} + c$$

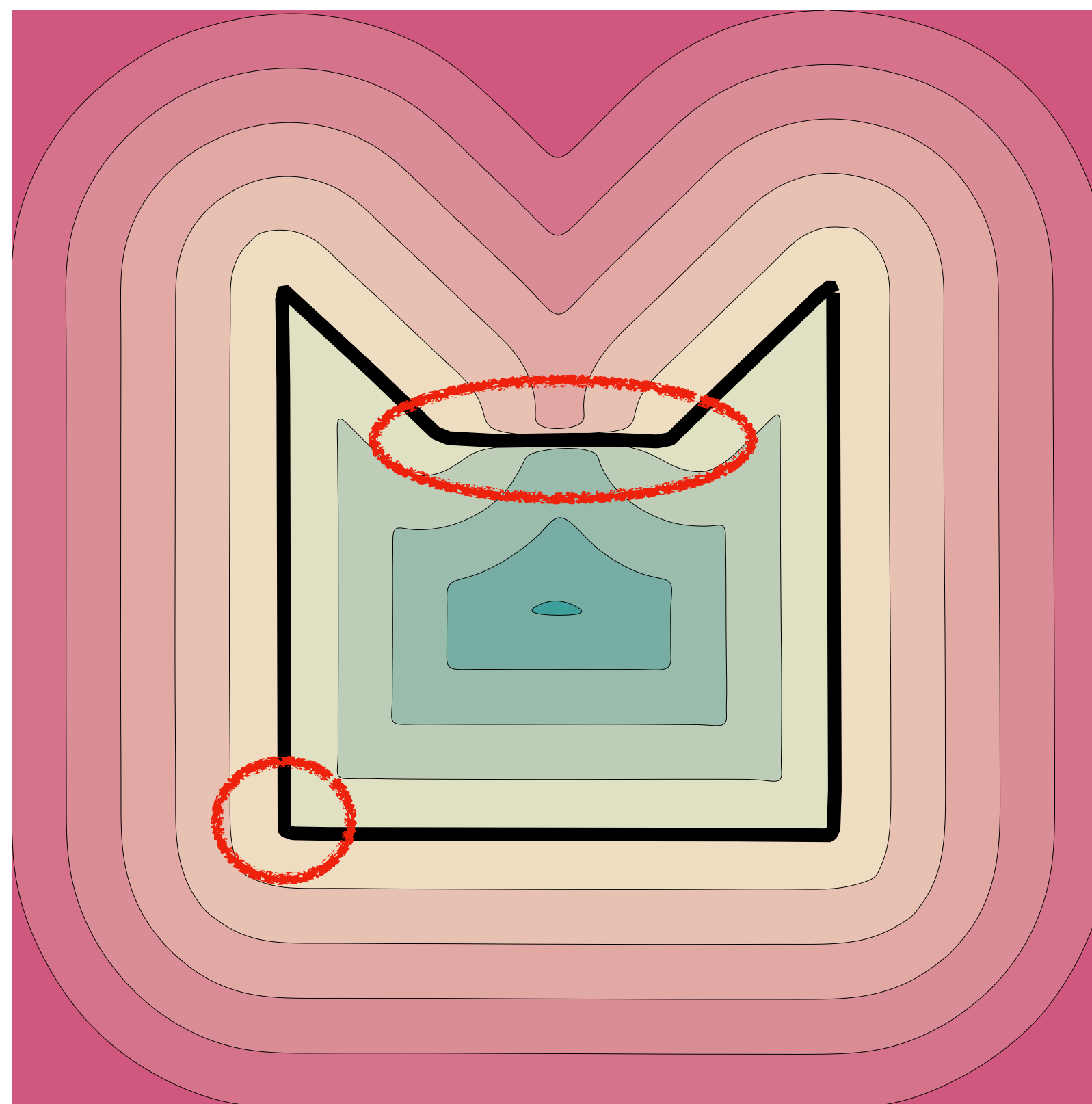


SALD

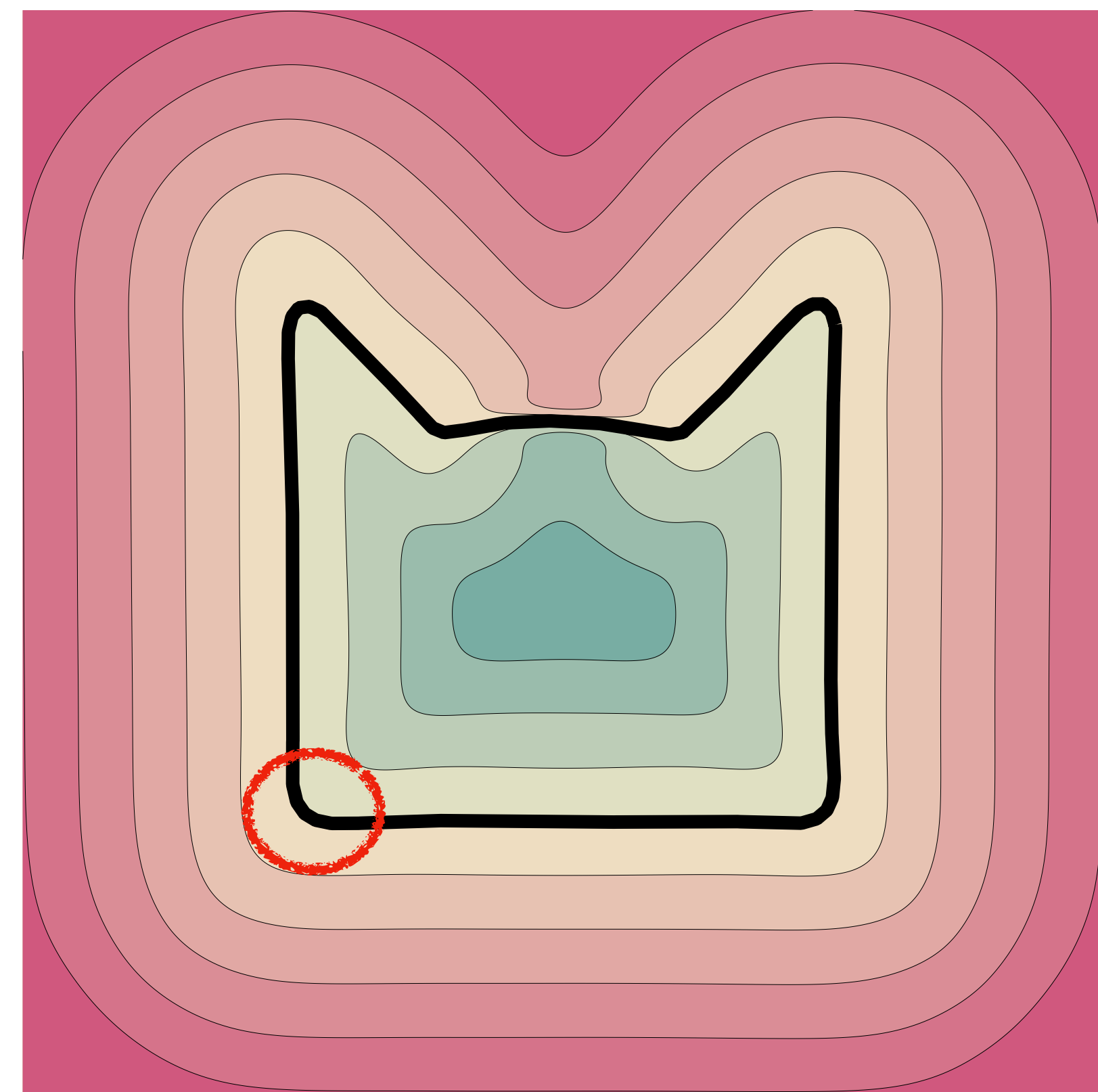
Sign Agnostic Loss with Derivatives : $\text{loss}(\theta) = \mathbb{E}_x \tau \left(f(x; \theta), h(x) \right)$



$\{h(x), \nabla h(x)\}$



SALD

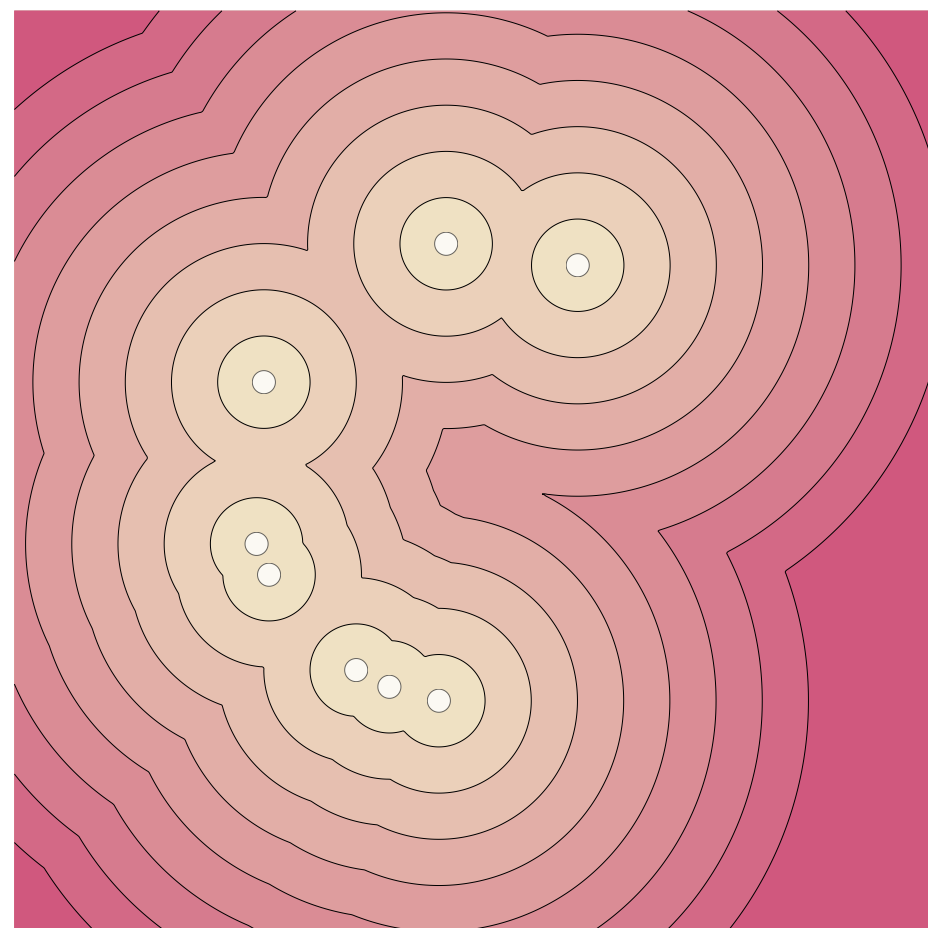
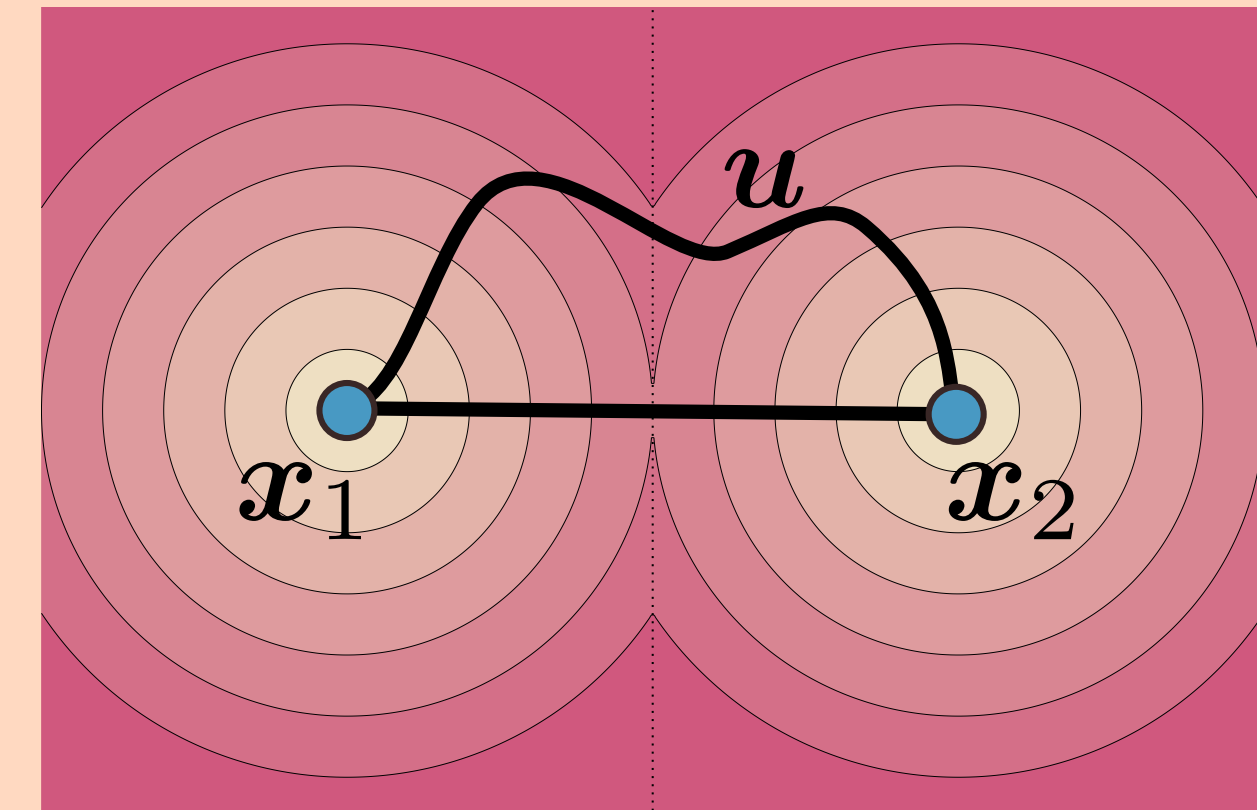


SAL

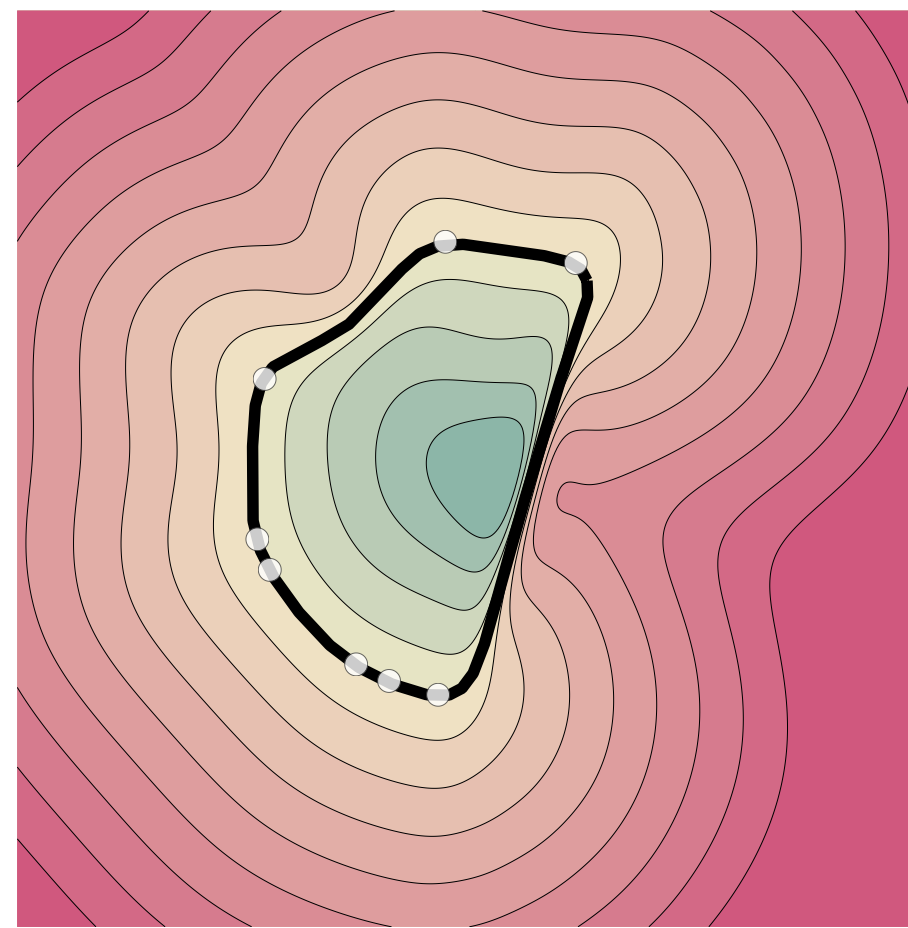
Minimal surface property

Theorem:

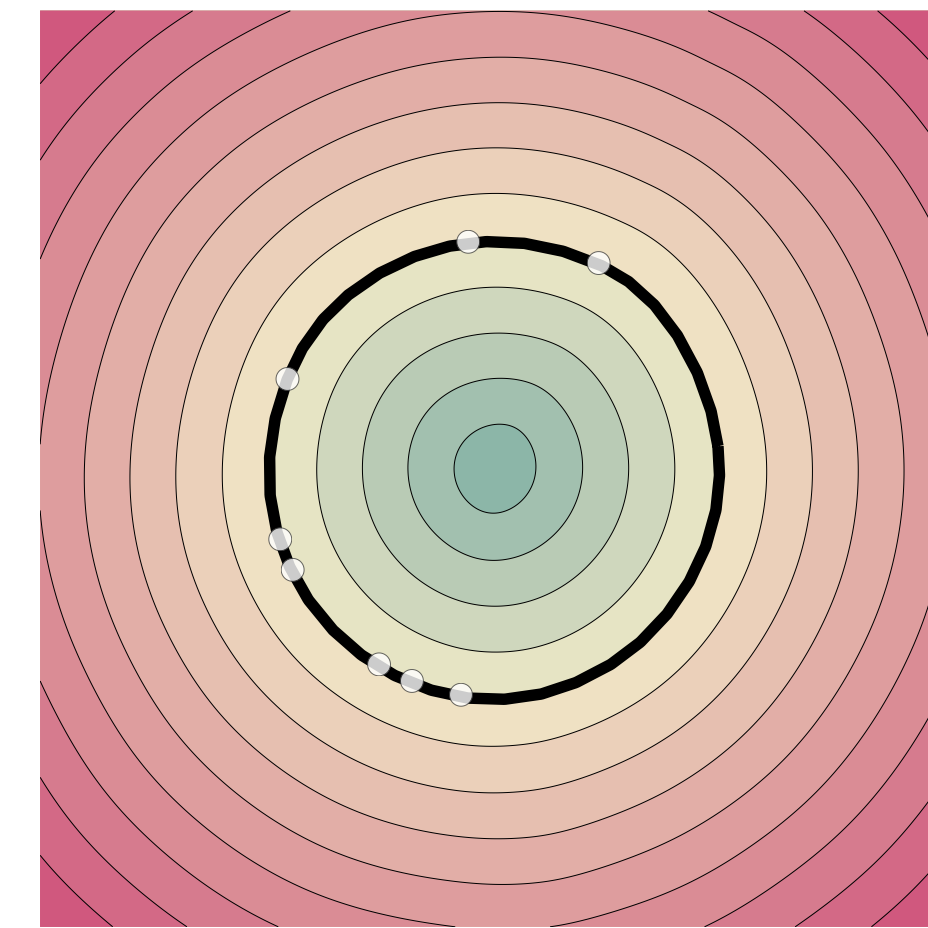
Between the two points $x_1, x_2 \in \mathbb{R}^2$,
the straight line is the strict global minimizer for SAL and SALD.



Input



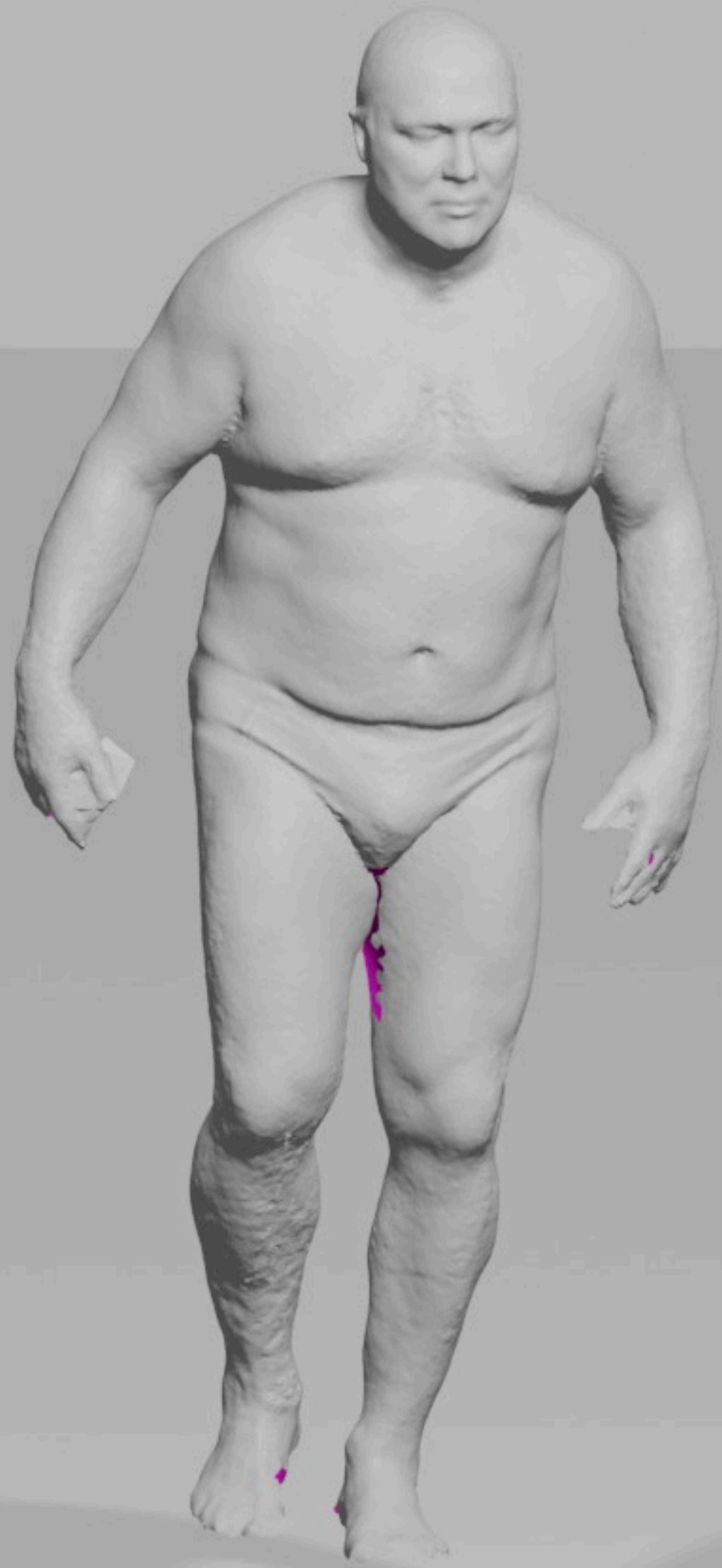
SALD



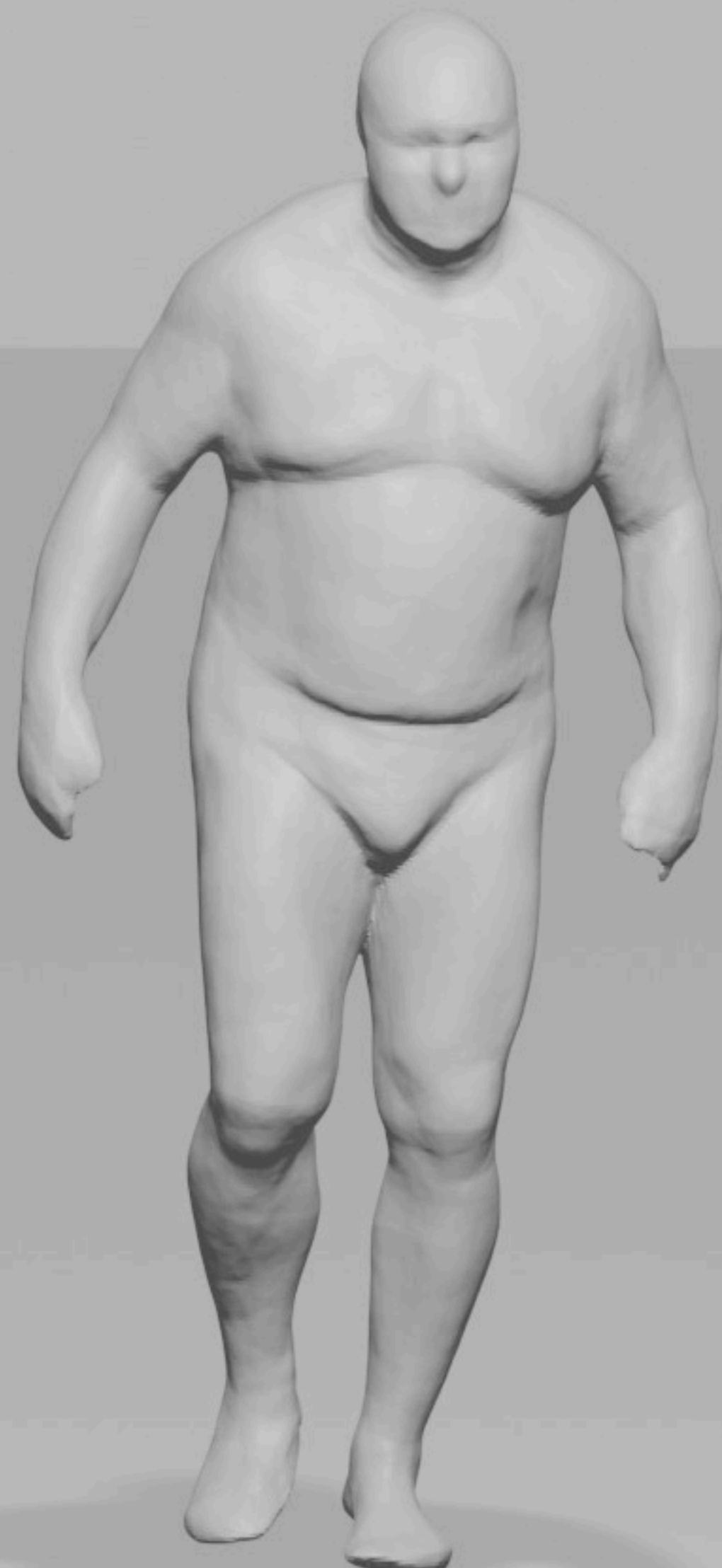
IGR

Experiments

DFaust test results



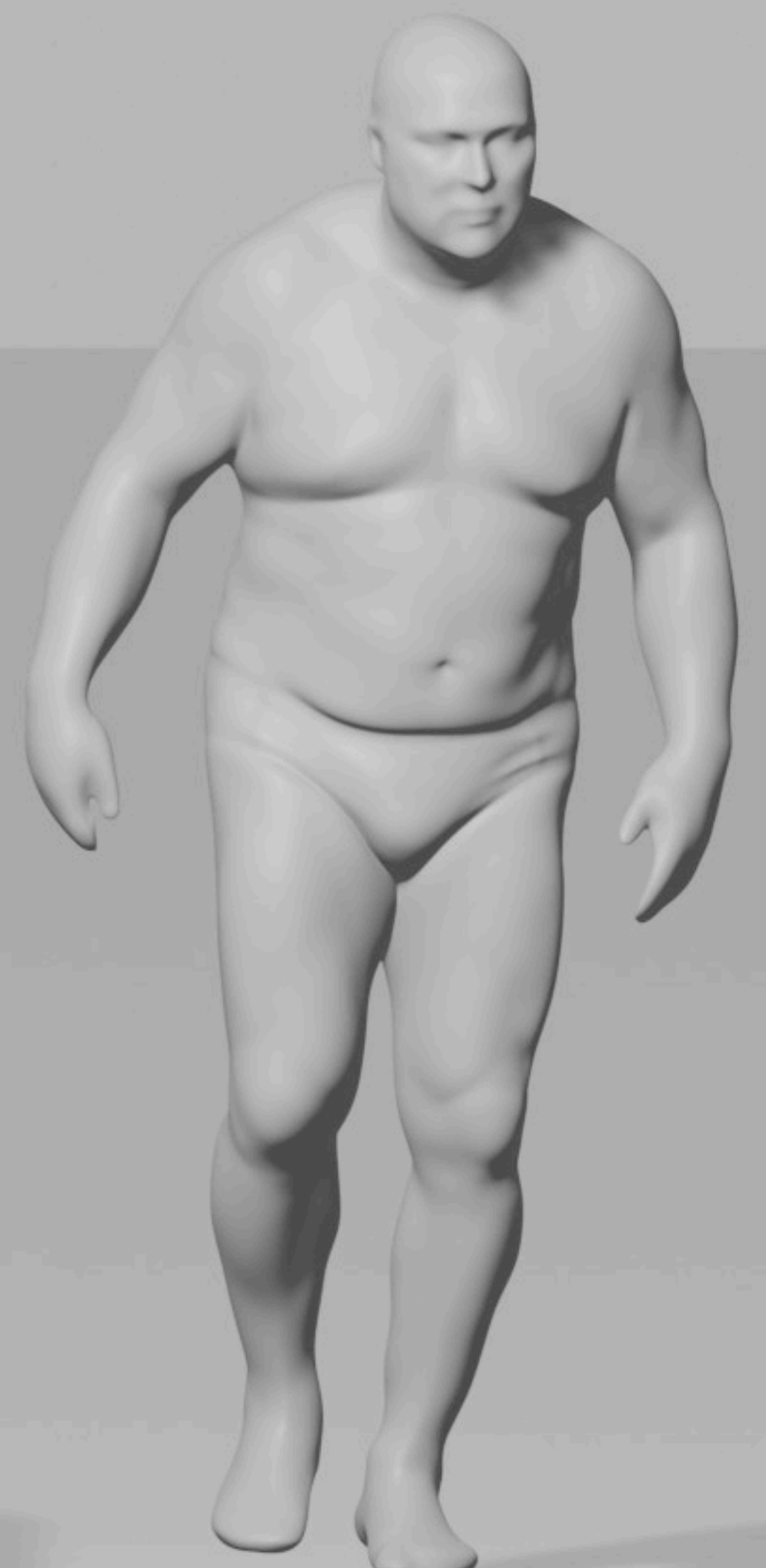
Input



SAL

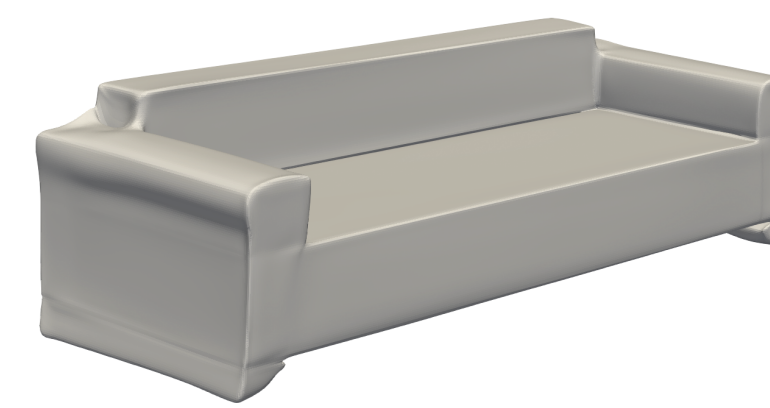
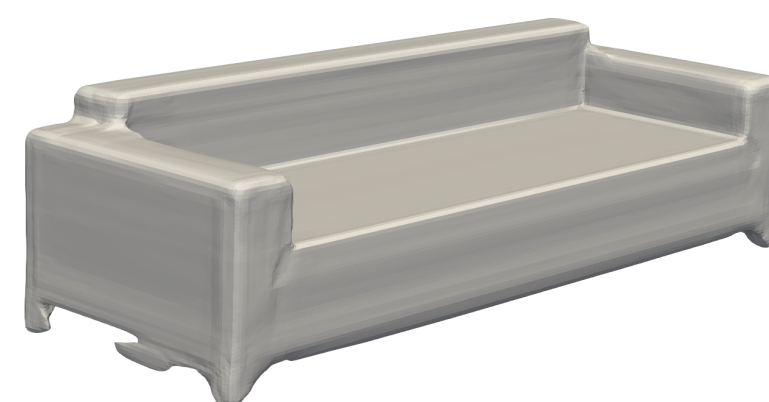
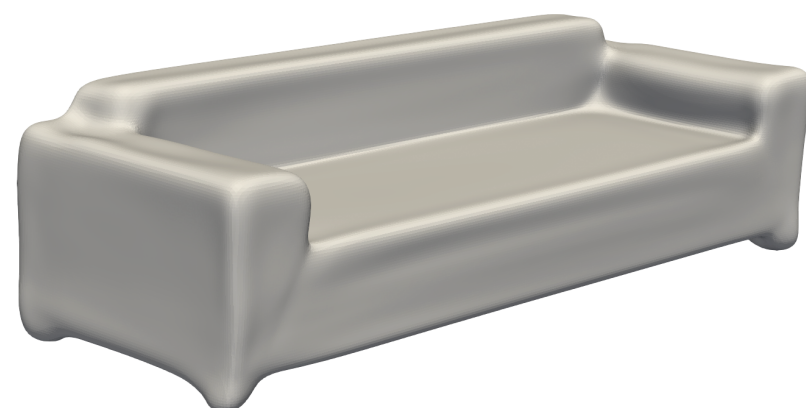
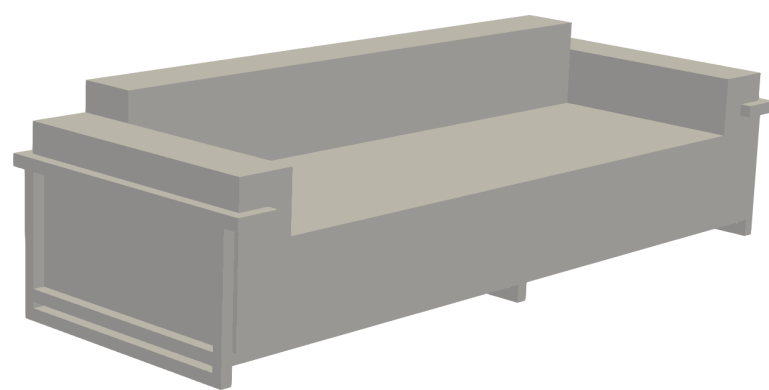
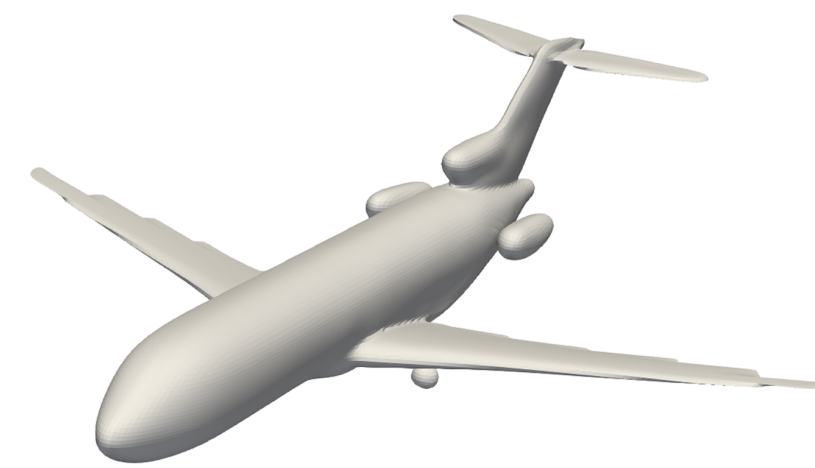
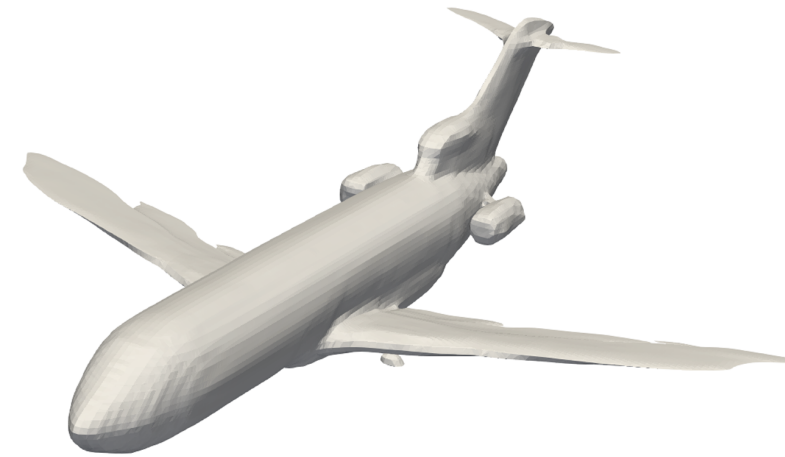
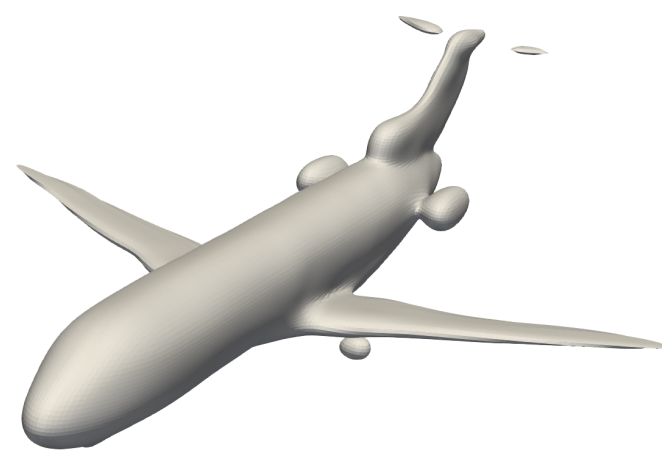
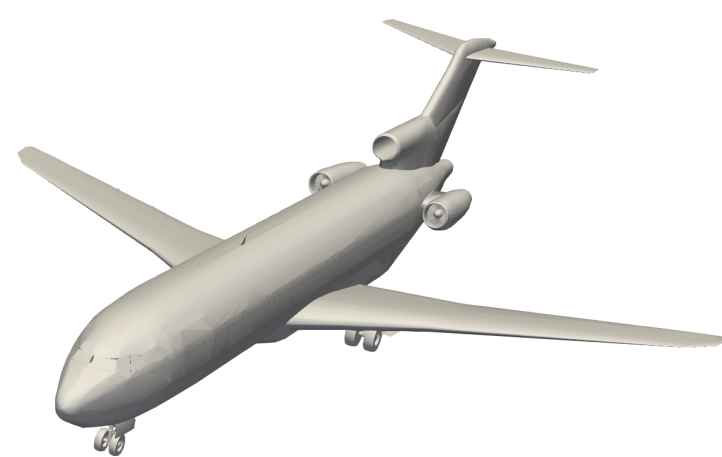


IGR



Ours

ShapeNet test results



Input

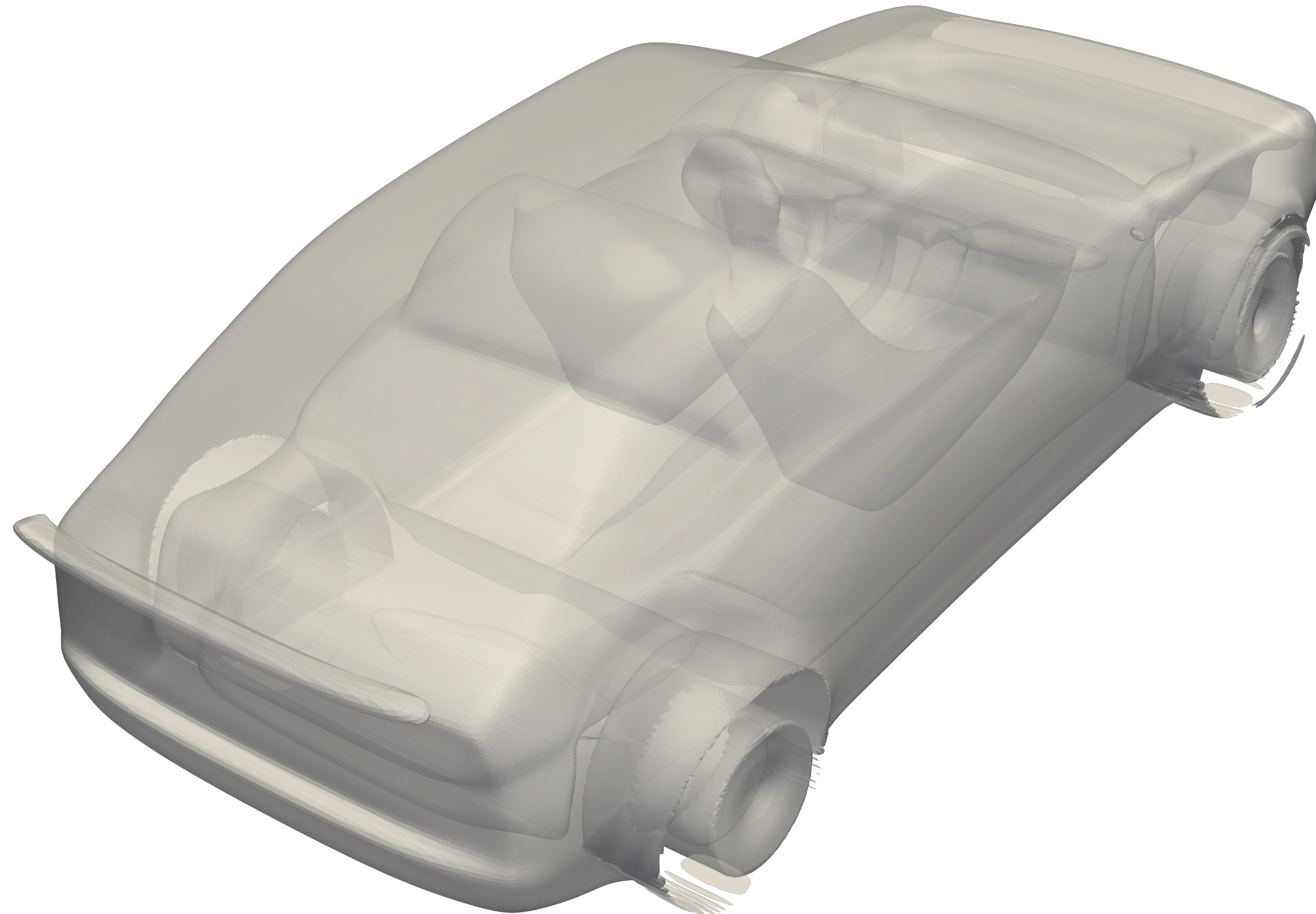
SAL

DeepSDF

SALD

Thank You

Our code will be public soon: <https://github.com/matanatz/SALD>



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